ANALYSIS OF THE WATER

OF THE

GREAT GEYSER, ICELAND.

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A sample of water taken from the Great Geyser Spring, in Iceland, was sent me by Dr. Little, of H.M.S. Coquette. It was collected on the 16th June, 1856, the temperature of the water being 190 degrees, and the temperature of the air forty-seven degrees. The quantity sent to me amounted to eight fluid ounces.

The water was bright and colourless; and on standing, it deposited no mechanical impurity. It had no odour; but a somewhat saline and alkaline taste. Its specific gravity, the thermometer being 73° (August, 1856), was a little above that of distilled water.

Its gaseous contents were oxygen and nitrogen; in the small quantity examined, there was no trace of free carbonic acid. It did not become turbid on boiling. It was alkaline, and retained an equal degree of alkalinity both before and after boiling.

Its hardness, as determined by the soap-test, was half a degree. It was quite as soft as distilled water; but the softness was owing to the absence of the salts of lime and magnesia, and to the presence of carbonate of soda.

On evaporation, it left a dry, almost white crystalline-looking residue, having a slightly brownish tint from the presence of a trace of oxide of iron. This residue was entirely mineral. There was no indication of the presence of organic matter either animal or vegetable. The residue was not deliquescent. Calculated for the imperial gallon it weighed 106·6 grains.

A chemical examination of the saline residue obtained from this water, showed that the only alkaline base contained in it

was soda. This was associated with carbonic acid, chlorine, sulphuric, and silicic acids; and the mineral constituents of the water, besides a minute trace of oxide of iron, were chloride of sodium, carbonate of soda, sulphate of soda, and silica,—the last being the preponderating mineral ingredient. The quantity of saline residue was too small to allow of a strictly accurate determination of the proportions of these ingredients, excepting the silica; but of the 106·6 grains, there were—

	Grains.
Soluble in Water	58·6
Insoluble in Water and Acids	48·0
Grains	106·6

The concentrated aqueous solution had a very strong alkaline reaction, owing to the presence of carbonate of soda. The sulphate of soda was estimated to form one fourth of the soluble salts, and the chloride of sodium one third; hence the constitution of the water based on these estimates would be :—

	Grains.
Carbonate of Soda	19·53
Chloride of Sodium	24·42
Sulphate of Soda	14·65
Silica and Matter insoluble in Water and Acids	48·00
Oxide of Iron (traces)	0·00
Grains in Imperial gallon	106·60

Many years ago an analysis of one of the Geyser waters was made by Dr. Black, and he found its constitution to be as follows, the quantities being reduced to the Imperial gallon :

	Grains.
Carbonate of Soda	6·51
Muriate of Soda	17·22
Sulphate of Soda	10·22
Silica	38·22
Alumina	3·36
Grains in Imperial gallon	75·53

The quantities of saline matter contained in the Imperial gallon differ, a result which is to be expected in waters taken from the same or similar springs, at periods very remote from

each other; but the ingredients found, are, for the most part, the same; and there is this striking feature in both analyses, that the water holds in a dissolved state a very large proportion of silica. The largest amount of silica found in cold spring water is about $\frac{1}{10,000}$th part, or seven grains in a gallon; in ordinary spring or river water, the proportion rarely exceeds two grains in the gallon.

Although silica is not very soluble in water, nearly 8000 parts of water being required to dissolve one part, even when the silica is in a state most favorable for solution, there are conditions connected with the water of the Geysers, which render this substance very soluble. These are the large amount of carbonate of soda present, and the high temperature of the water in the earth. As to the first condition, it has been recently determined that the solvent action of water on silica is great in proportion to the amount of carbonate of soda or alkaline carbonate present. The silica appears to be dissolved as silicic acid, at any rate it does not separate by evaporation as silicate of soda; and it does not displace the carbonic acid from the carbonate when evaporated to dryness, and the residue is moderately heated. Another condition which affects the solubility of this substance is the high temperature of the water. In July, 1846, Bunsen found the temperature of the water (before an eruption) at the bottom of the Geyser, (about seventy feet) to be 261 degrees. At this temperature, the pressure is equivalent to two atmospheres, or thirty pounds on the inch; and this pressure, combined with the heat, is probably favorable to the solution of silica in water.

The source of this silica appears from recent researches to be—the volcanic silicious minerals known as phonolite, basanite, and dolerite, which are contained in the upper layers of the volcanic soil around the springs. Analysis has shown that unaltered phonolite contains 72·3 per cent. of silica, while the rock altered by exposure to the water, contains only 65·8 per cent.

The silica contained in the Geyser water is not precipitated by mere cooling, but it is slowly deposited on all surrounding objects, as the water evaporates, and the solvent,—carbonate of soda is withdrawn.